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The Effect Of Substitution Of Coarse And Fine Aggregates With Shells Of Blood Clams And Cement With Fly Ash And The Additional Of Superplasticizer Against The Compressive Test

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Abstract

Concrete generally composed of four main constituent materials namely portland cement, fine aggregate (sand), coarse aggregate (gravel), and water. The large amount of use of concrete in construction results in an increase in the demand for concrete materials, thus triggering the mining of concrete materials on a large scale which caused the decline in natural resources in Indonesia for the need for concrete material. If needed, substitute materials can be created in such a way as to change certain properties of concrete to function better, economically, and environmentally friendly. The waste of fly ash and shells of blood clams can be used as a substitute for cement, coarse aggregates and fine aggregates. The purpose of this research is to determine the compressive strength of the variation of the percentage of fly ash substitution with cement and shells of blood clams with coarse and fine aggregates and the addition of superplasticizer to the compressive strength of concrete. The research is using experimental methods, test specimen samples will be tested for workability, density, and compressive strength. Variable in the research are (1) related variables : density and compressive strength, (2) independent variable : variation of 0%, 5%, 10%, and 15% of blood clam shell needs of the total weight of coarse aggregate. Based on the results of the research concluded that (1) Slump value of the samples 0%, 5%, 10%, and 15% consecutive is 97mm, 89mm, 151mm, 149mm. (2) density of concrete with substitution of blood clam shells with coarse aggregate with samples 0%, 5%, 10%, and 15% consecutive is 2284 Kg/m3, 2308 Kg/m3, 2297 Kg/m3, and 2293 Kg/m3. (3) Testing of concrete compressive strength at 28 days with substitution of blood clam shells with coarse aggregate with samples 0%, 5%, 10%, and 15% consecutive is 21.44 Mpa, 24.38 Mpa, 19.02 Mpa, and 19.34 Mpa. The composition of substitution of blood clam shells with coarse aggregate of 5% has a higher compressive strength than other compositions.

Keywords :
Compressive Strength, Density, Fly Ash, Slump, Superplasticizer, The Substitution Of Blood Clam Shells

1. Introduction

Indonesia is a country that is developing its infrastructure, especially in the construction sector. In 2019, it was noted that the budget that the government has spent on infrastructure development according to the ministry of finance reached 415 trillion rupiah (Kementrian Keuangan RI, 2019). This causes construction materials such as concrete to be widely used for various construction needs in Indonesia, such as roads, bridges, piers, and so on.

Concrete generally composed of four main constituent materials, namely Portland cement, fine aggregate (sand), coarse aggregate (gravel), and water (BSN, 2013). The large amount of use of concrete in the construction has resulted in an increase in the need for concrete material, thus triggering the massive mining of concrete material which has resulted in a decline in natural resources in Indonesia for the purposes of concrete materials.

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Figure 1. Cylindrical specimen sample
Source : jharwinata.blogspot.com,2019 (Harjawinata, 2019)

In this study, the authors added several types of substitutes for the concrete mixture, the materials used in creating the concrete were blood clam shells (anadara granosa) as an alternative material for partial substitution of fine aggregate (sand) and coarse aggregate (gravel), and the author also added fly ash as a partial substitution of cement.

And in this study the authors also added a concrete added material, namely admixture in the form of a superplasticizer, which is expected to increase the compressive strength of the concrete, and also make it easier to work.

This study aims to determine the amount of compressive strength of the variation in the percentage of substitution of cement with fly ash and coarse and fine aggregates with shells of blood clams and the addition of superplasticizer to the compressive strength of concrete. The amount of substitution of the concrete material can be seen in the table below.

Table 1. Variation of Substitution material

Material	Sample1	Sample 2	Sample 3	Sample 4
Shells of Blood Clams – Fine Aggregate	5%	5%	5%	5%
Shells of Blood Clams – Coarse Aggregate	0%	5%	10%	15%
Fly ash – Semen	10%	10%	10%	10%
Superplasticizer – Semen	2%	2%	2%	2%

Source : Data in research, 2020

The blood clam (Anadara Granosa) has two shells that can open and close using the adductor muscles in its body. The dorsal shells is thick and the ventral part is thin. This shell consists of 3 layers, namely (1) periostrakum is the outermost layer of chitin which function as a protector (2) the prismatic limestone crystal, (3) the nakreas layer or often called the mother of pearl layer, is composed of a thin parallel layer of calcite (carbonate). The hardness of the shells does not depend on the age of the shells, meaning that both young and old shells have the same hardness (Pathansali, 1966).

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Figure 2. Blood Clams
Source : bulelengkab.go.id

Fly ash is defined as fine grains resulting from the residue of burning coal in power plants. Fly ash has a melting point of about 1300°C and has a mass density, between 2.0 – 2.5 g/cm^3. Fly ash is one of the residues produced in combustion and consists of fine particles (Wikipedia, 2020).

Additive (admixture) is a material in the form of powder or liquid, which is added to the concrete mixture during stirring, with the aim of changing the properties of the mortar or concrete (Departemen Pekerjaan Umum, 1982).

2. Methodology

The method used in this research is an experimental method, in which the sample of the test object will be tested for workability, density, and compressive strength after reaching the test age. The calculating of the mix design plan refers to SNI 7656-2012. (BSN, 2012)

Table 2. Mix Design requirements

Description	Information
Compressive strength target, f'c	21 Mpa
Determination of cement type	Type 1
Determination of water cement ratio	0,670
Determination of slump value	75-100 mm
Determination of the maximum size of coarse aggregate	25 mm

Source : Data in research, 2020

This research was carried out starting from the preparation stage, the material testing stage, the mixing stage, the test object manufacturing stage, and the test object treatment stage as well as the concrete testing stage (slump testing, density testing, and compressive strength testing) as well as the data analysis stage. In addition, this research and testing was carried out in the RnD laboratory of PT. Solusi Bangun Beton (Narogong).

From the result of the plan, a sample of the test object was made to determine the mechanical properties of normal concrete. Sample the specimen used is a cylinder with a diameter of 15 cm and a height of 30 cm for the compressive strength test. Testing of a test object will be carried out after the concrete is 28 days old, as for the need for sample specimens for testing the compressive strength is 24 cylinder. Sample details are presented in the table below.

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Table 3. Detail of test object

Test	Information	Test plan			Total
		3 days	7 days	28 days	
Compressive test	Sample 1	2 pcs	2 pcs	2 pcs	6 Pcs
	Sample 2	2 pcs	2 pcs	2 pcs	6 Pcs
	Sample 3	2 pcs	2 pcs	2 pcs	6 Pcs
	Sample 4	2 pcs	2 pcs	2 pcs	6 Pcs
Total of sample					24 Pcs

Source : Data in research, 2020

Meanwhile, the data on material requirements for the proportion of concrete mixture for every 6 samples of specimens for each job mix can be seen in the table below.

Table 4. The proportion of the sample mixture of the test object

Description	Unit	Tm-1	Tm-2	Tm-3	Tm-4
		0%	5%	10%	15%
		11-Jun-2020	11-Jun-2020	12-Jun-2020	12-Jun-2020
Type of 1	Kg	10.53	10.53	10.53	10.53
Fly Ash	Kg	1.18	1.18	1.18	1.18
Fine aggregate	Kg	33.43	33.43	33.43	33.43
Shell of blood clam	Kg	1.76	1.76	1.76	1.76
Coarse aggregate	Kg	43.25	41.09	38.93	36.76
Shell of blood clam	Kg	-	2.16	4.33	6.49
Superplasticizer	Ltr	0.12	0.12	0.12	0.12
Water	Ltr	5.23	5.23	5.23	5.23

source : Data in research, 2020

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3. Result and Discussion

3.1. Coarse aggregate

The following are the results of coarse aggregate testing carried out in the laboratory, which can be seen in the table below :

Table 5. Coarse aggregate testing

Type od testing	Results
Sieve analysis	7.4
Specific gravity SSD	2.6
Absorption	1.74%
Water content	5.27%
Unit Weight	1440
Material finer than 200 micron	0.9%

Source : Data in research, 2020

3.2. Fine Aggregate

The following are the results of coarse aggregate testing carried out in the laboratory, which can be seen in the table below:

Table 6. Fine aggregate testing

Type of testing	Results
Organic impurities	No.5
Sieve analysis	2.4
Specific gravity SSD	2.59
Absorption	0.8%
Water content	4.12%
Unit weight	1380
Material finer than 200 micron	1.13%

Source : Data in research, 2020

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3.3. Shell of blood clam

To test the blood clam shells, pound it until it passes filter no.4 as a substitute for fine aggregate and passes the 1 inch sieve and gets stuck in the ½ inch sieve for substitute of coarse aggregate.

3.4. Slump value

Here is a workability test using a slump tester can be seen in the table below :

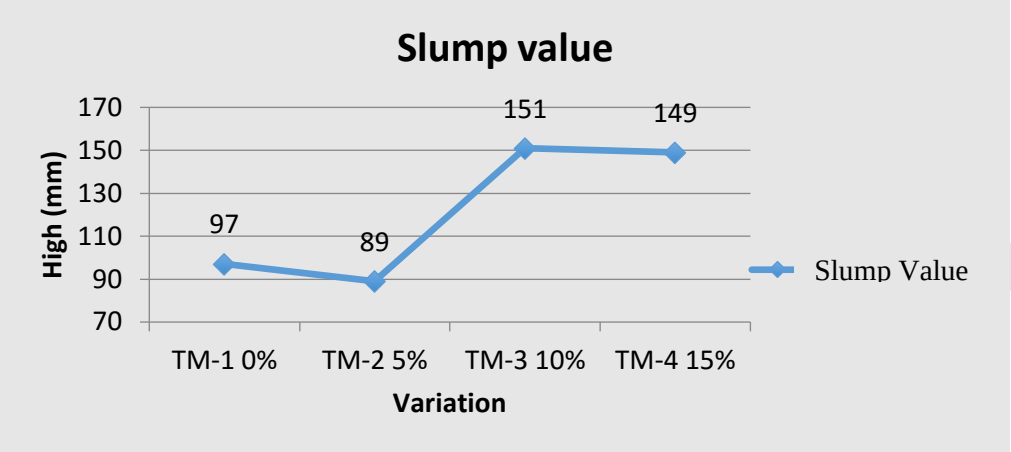

Figure 3. Slump value graph

Source : Data in research, 2020

3.5. Density

Here are the result of the density test, which can be seen in the table below :

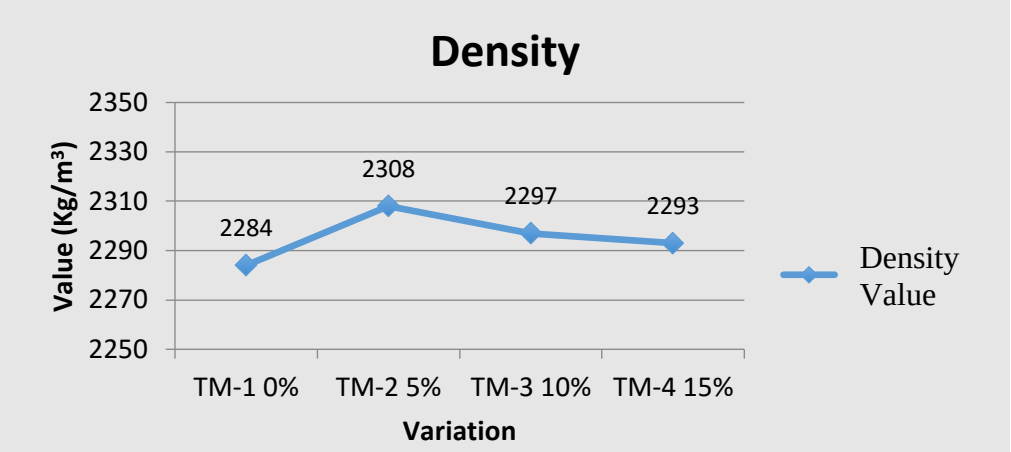

Figure 4. Density value graph

Source : Data in research, 2020

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3.6. Compressive strength test

Here are the results of the compressive strength test can be seen in the table below :

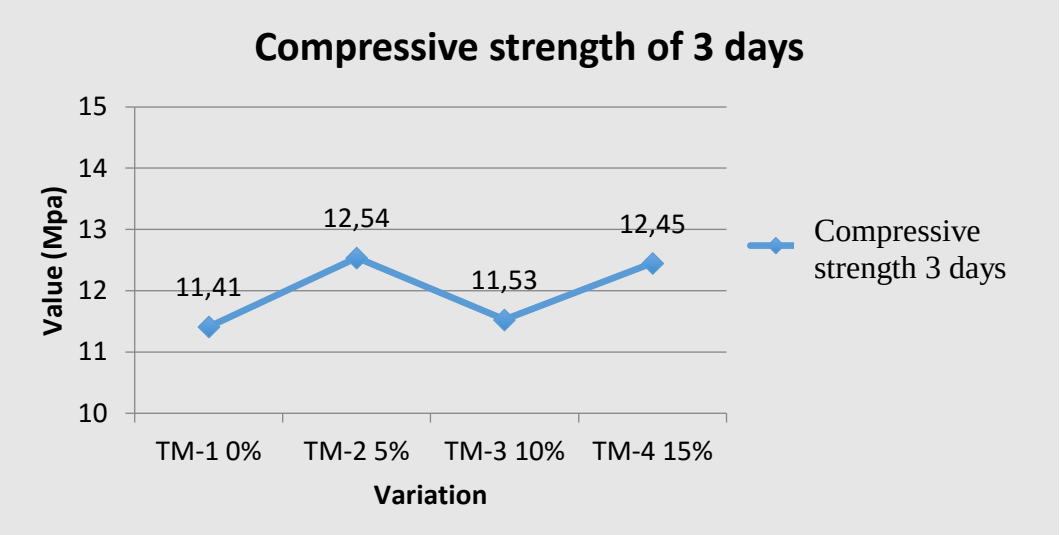

Figure 5. Graph of 3 days age concrete compressive strength
Source : Data in research, 2020

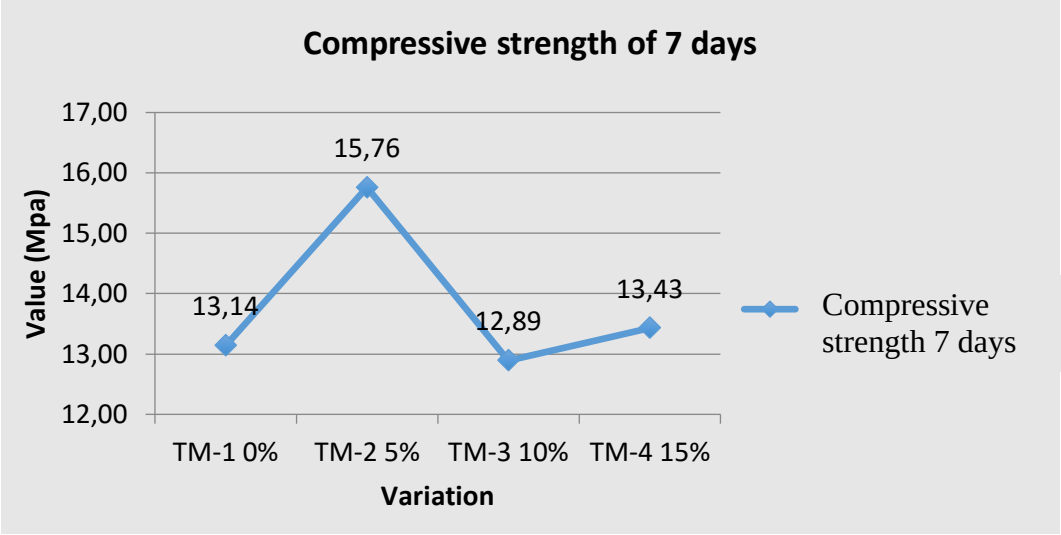

Figure 6. Graph of 7 days age concrete compressive strength
Source : Data in research, 2020

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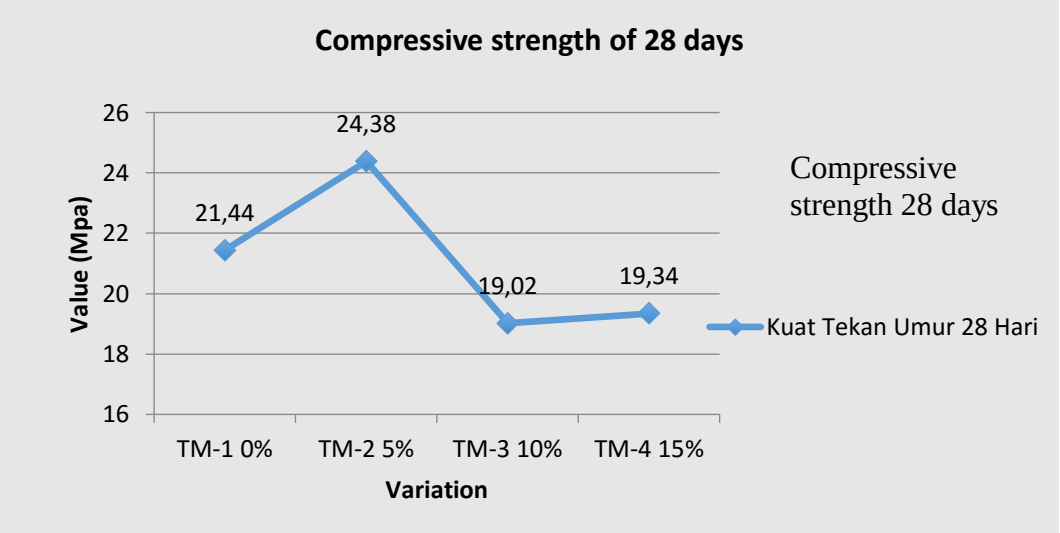

Figure 7. Graph of 28 days age concrete compressive strength
Source : Data in research, 2020

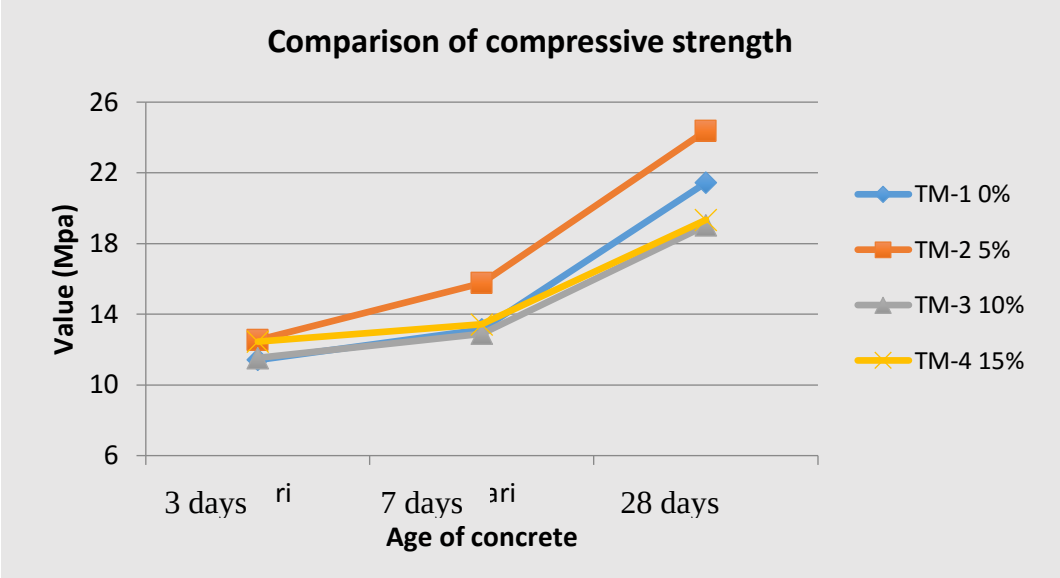

Figure 8. Comparison of compressive strength
Source : data in research, 2020

4. Conclussion

From the test results, the following results are obtained :

1. The slump value on the first day of sample making with the second sample making day has a very significant difference, respectively 97 mm, 89 mm, 151 mm, 149 mm. This is because at the time of making the sample of the test object on the second day the weather was bad (Rainy), this can affect the value at which the sample is made.
2. The density with substitution of blood clam shells with coarse aggregate is still in the normal proportion of concrete which has a weight of 2284 kg/m3, 2308 kg/m3, 2297 kg/m3, and 2293 kg/m3. For normal concrete content weight itself, which is between (2200-2500) kg/m3.
3. In testing the compressive strength of concrete aged 3 days, the results obtained are 11.41 Mpa, 12.54 Mpa, 11.53 Mpa. The composition of blood clam shell substitution with coarse aggregate 5% which has a higher compressive strength which is 12.54 Mpa.
4. In the 7 days old compressive strength test, the results obtained were 13.14 Mpa, 15.76 Mpa, 12.89 Mpa, and 13.43 Mpa. The composition of blood clam shell substitution with coarse aggregate 5% which has a higher compressive strength which is 15.76 Mpa.
5. In the 28 days old concrete compressive strength test, the results were 21.44 Mpa, 24.38 Mpa, 19.02 Mpa, and 19.34 Mpa. The composition of blood clam shell substitution with coarse aggregate 5% which has a higher compressive strength which is 24.38 Mpa.
6. In testing the compressive strength of concrete aged 3,7, and 28 days, the composition of the substitution of blood clam shells with 5% coarse aggregate has a higher compressive strength.
7. The test results on TM-3 10% and TM-4 15% on the second day did not reach the planned target of 21 Mpa due to bad weather (rainy) which resulted in the material increasing so that when the slump test exceeded the target, which was 151 mm and 149 mm. This effects the value (w/c) of the concrete mixture.

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